Global Positioning Experiment (GPX)

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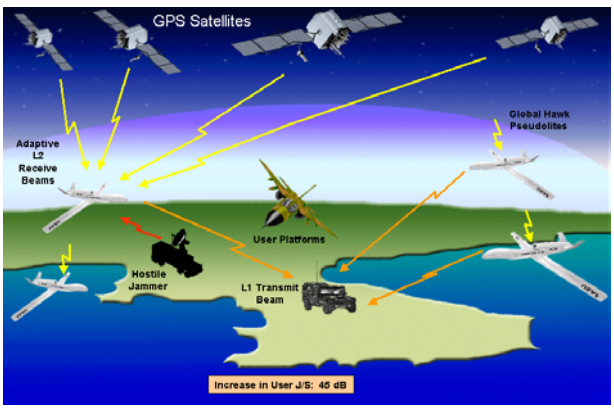
The GPX program is aimed at solving the GPS jamming threat. GPS jammers are an insidious threat. GPS signals are very weak and easy to jam. Jammers can be built with cheap, easy-to-get components, and are so small that it's difficult to find them. Bottom line is that any adversary could deploy large numbers of GPS jammers, and we would never know it until a conflict began.

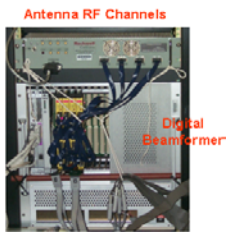
GPX Concept

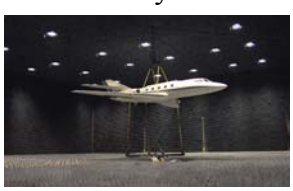


DARPA is solving the problem of GPS jamming by developing airborne pseudo-satellites (or "pseudolites") which provide high power GPS signals that overpower jammers. A pseudolite system can be thought of as being a miniature GPS constellation. Four pseudolites are required for a full navigation solution, just like four GPS satellites are required today. The concept is that the airborne pseudolites would find their own position from GPS satellites, even in the presence of jamming. The pseudolites do this through a state-of-the-art beamforming antenna and signal processor that decrease the effects of jamming. Then they transmit a GPS-like signal to the friendly air and ground forces at much higher power and at closer range than the satellites. The pseudolite signal overwhelms the jammer and allows the multitude of users to ignore the jamming and continue to navigate.

At DARPA Tech 2000, it was reported that the GPX program had successfully shown accurate navigation via pseudolites in a series of field tests by Rockwell-Collins in November 1999. It was also shown that the pseudolites were powerful enough to overcome jamming in April 2000.

Since these first two field demonstrations, the program has focused it's efforts on making the pseudolite itself immune to jamming, since the pseudolite platform has to navigate using the GPS satellites. To do this, a seven element antenna array and a state of the art digital beamformer to reject jamming signals at the pseudolite have been developed. MIT Lincoln Laboratory and Rockwell Collins have built a system to give 40-55 dB of jamming immunity, using a combination of space and time adaptive processing. The system has been tested in a mini-anechoic chamber, at the Air Force GPS Wavefront Simulator at Wright-Patterson AFB, and in some rudimentary field tests, and has met its goals. This April the system was integrated on a Lincoln Laboratory Falcon 20 aircraft. The entire system was tested in a full scale anechoic chamber at the Patuxent River Naval Air Station. The results met the goals of the program. In September, the Falcon will fly in a live jamming





field at Holloman AFB, New Mexico. The flight testing will determine if the pseudolite system successfully rejects jammers, and see if it maintains a highly accurate pseudolite signal while the jammers are on. The expectation is that it will succeed quite well, based on previous testing.

The GPX program will end in the summer of 2003. A pair of field demonstrations are scheduled to show a full system of four airborne pseudolites providing accurate navigation to a variety of users, including precision weapons, while being jammed. These demonstrations will also include a shaped beam transmission antenna for the pseudolite signal, and a command and control system that manages the pseudolite network transmissions.

The pseudolite approach to GPS jamming mitigation is a unique one. It transmits a stronger signal than the satellites. A pseudolite system could be deployed rapidly and recalled for use elsewhere. It also does not require expensive hardware modifications to the thousands of DoD users. In short, it has many advantages. We at DARPA are working to find transition partners in the DoD and industry at the same time that the program demonstrates solutions to all the technical issues. If you are interested in working with DARPA to transition pseudolites, see Lt Col Gregory Vansuch DARPA/SPO.

GPX Schedule